TORONTO HARBOUR STUDY
1976 to 1979
VOLUME 1
BACKGROUND INFORMATION

Ontario
Ministry of the Environment

The Honourable
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Minister

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Deputy Minister

TORONTO HARBOUR STUDY

1976 to 1979

VOLUME I - BACKGROUND INFORMATION

DON RIVER DIVERSION UNDER CONSTRUCTION AT KEATING'S CHANNEL, OCTOBER 28, 1914

Photo Courtesy Toronto Harbour Commissioners Archives

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Title Page Photograph

The Don River has always had a significant impact on Toronto Harbour. It originally flowed both into the Harbour itself and also into the former Ashbridge's Marsh. Debate concerning its diversion into the Harbour, into the Marsh or out into Lake Ontario continued from the 1830's until the early 1900's. This view looking east from a derrick tower at the approximate location of the Cherry Street bridge shows Don diversion construction in the old Keating's Channel. Moored in the left foreground is a Toronto Harbour Commissioners pile driver, with two T.H.C. hydraulic dredges in the middle of the picture. The completed work diverted all Don River flow into the Harbour as it still does today.

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All photographs, maps and information sources are acknowledged in the text or references.

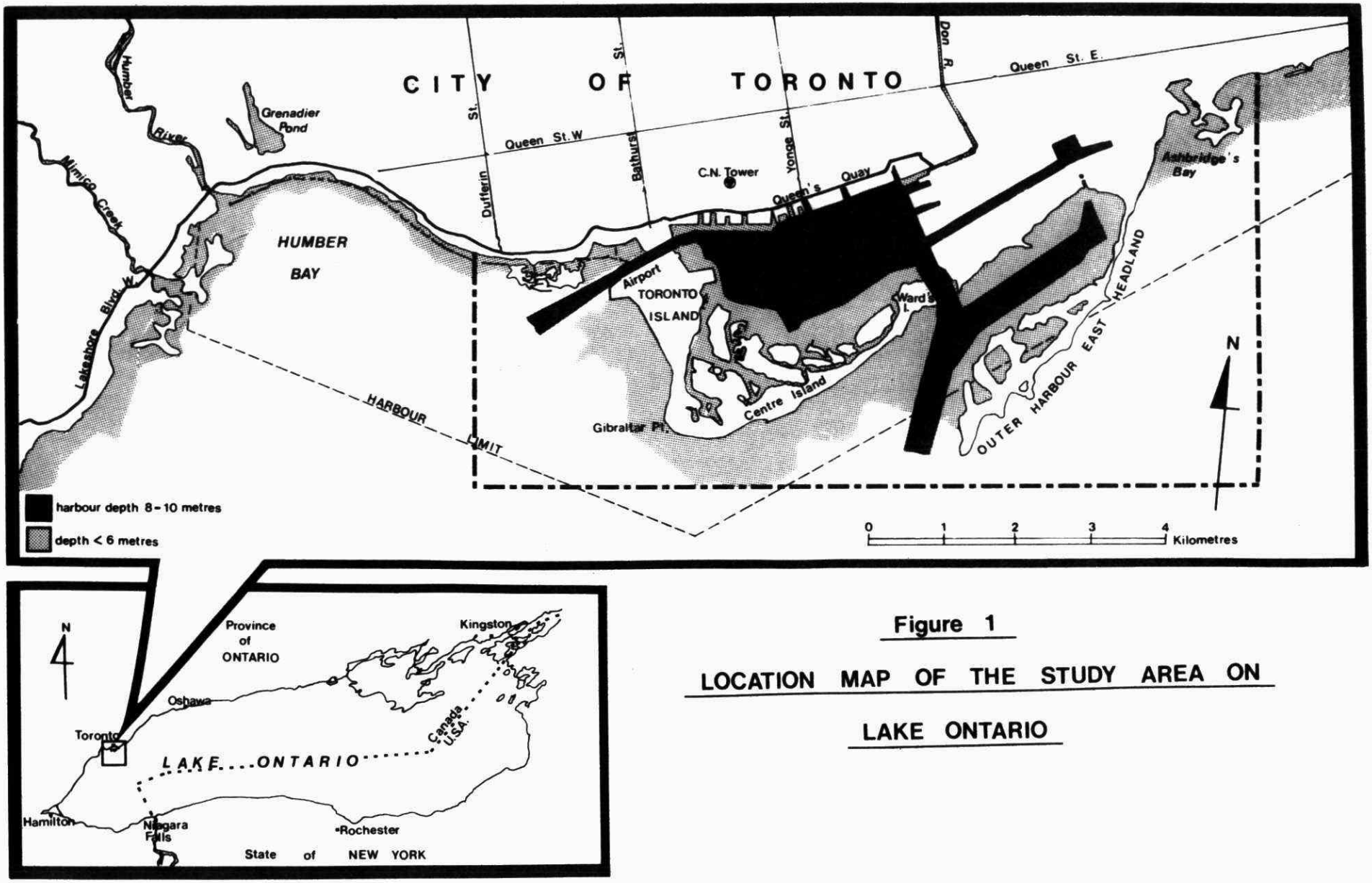


Figure 1

LOCATION MAP OF THE STUDY AREA ON LAKE ONTARIO

I INTRODUCTION AND PURPOSE OF STUDY

The Toronto waterfront has undergone extensive modification and development since initial European settlement in the late 1700's and the original "pristine" water and wildlife environment has long since disappeared. However, overall water quality and water use in Toronto has fared reasonably well compared with other large urban centres in North America [1] and on the Great Lakes.

The Metropolitan Toronto area is one of very intensive and often conflicting water uses - swimming, boating, fishing, wildlife, port facilities, industry, municipal drinking water and sewage disposal and major lakefilling activities. The use and quality of the waterfront is influenced by numerous governmental agencies which have complex regulatory and operational jurisdictions over port and recreational development, environmental protection, power generation, waste disposal, etc. These include: Ministries of the Environment and Natural Resources, Metro Toronto and Region Conservation Authority, Ontario Hydro (Provincial); Transport Canada, Environment Canada (Federal); Toronto Harbour Commissioners (Federal-Municipal); Metro Works Department, City of Toronto Public Works, Metro Parks Department, City Planning Department (Municipal).

Intensive waterfront planning efforts have been carried out over the last decade (Harbourfront Park, Toronto Islands Park and Airport site, new City of Toronto Waterfront Plan) and development of residential and recreational uses has increased in former industrial, port and utility areas (Aquatic Park, Toronto Outer Harbour and other lakefill sites, Harbour Castle Hotel and apartments). Thus the Ministry of the Environment (MOE) was prompted to conduct intensive studies of the water and sediment quality of the Toronto waterfront during the period 1976 - 1979 in order that realistic, water-related planning and development decisions could be made. Although most intensive studies were conducted in the City of Toronto Inner and Outer Harbour areas, the

significant regional (Metropolitan Toronto) water quality aspects were also assessed to the extent that limited resources allowed. In addition to providing a detailed environmental data base, the MOE studies were designed to provide water quality information on remedial measures. Of particular interest were conditions before and after construction and operation of the new Mid-Toronto Interceptor Sewer, impact of a new Island Park sewer system and long term effects of the City of Toronto's 25 year sewer system rehabilitation programme which began in the late 1960's.

This is the first in a series of MOE Great Lakes Surveys Unit reports on the Toronto Harbour area.* This volume provides a brief historical perspective and detailed review of water and water-related uses along the Toronto waterfront. Future volumes will provide a comprehensive data presentation for field years 1976, 1977, 1978 and 1979 and an assessment of the bacteriological, chemical and sediment components of the Toronto Harbour ecosystem. It is anticipated that these reports will be of use to the agencies and consultants involved in planning and development along the Toronto waterfront and to the general public and educational institutions as an information and data source.

* The MOE Lakes Systems Unit has produced reports on currents, harbour-lake exchange and modelling as part of the overall MOE study effort on Toronto Harbour.

II DESCRIPTION OF THE STUDY AREA

Metropolitan Toronto is located on the north shore near the western end of Lake Ontario (Figure 1). It is the commercial, industrial and administrative hub of the Province of Ontario and is the largest population centre on all of Lake Ontario (2,124,291 according to 1976 Federal Census figures).

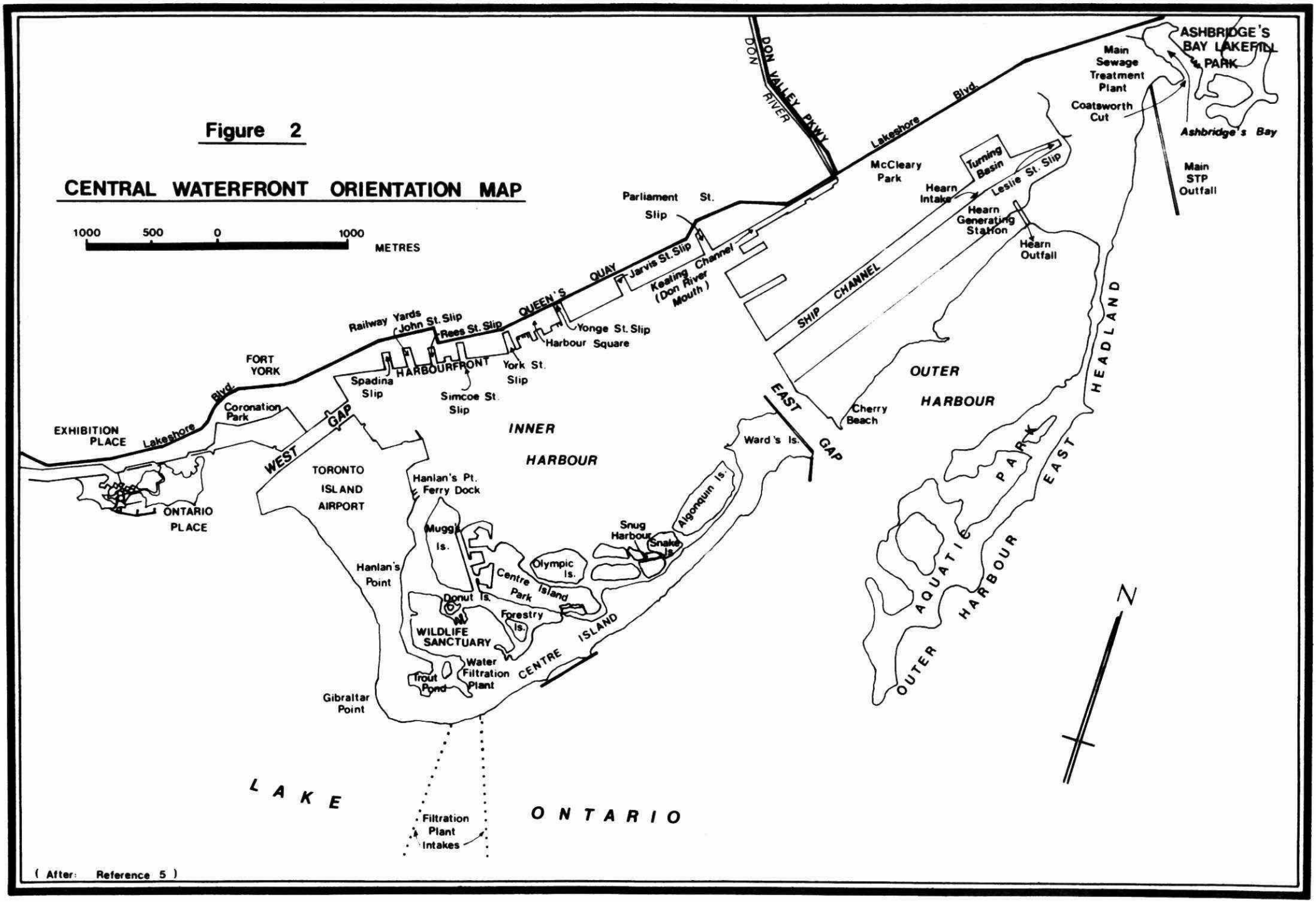
The area being studied in detail in this report is shown enclosed in a heavy dashed line in Figure 1 and an orientation map of existing place names, gaps and channels is shown in Figure 2.

A brief review of the historical development, geography and geomorphology of the study area is included here, to provide an understanding of how water quality has been and is now affected by the dynamics and interactions of the Lake, the Harbour, the Don River and sewer runoff.

(a) Historical Perspective:

At the time of the first European settlement of the Toronto area in the 1790's the lake was lined with "dense and trackless forests"[2], Toronto Bay was "beautifully clear and transparent"[3] and the "neighbouring marshes were the hitherto uninvaded haunts of immense coveys of wild fowl"[2]. The Don River meandered unpolluted into the Harbour and into the Ashbridges Bay marsh area (Figure 3). Salmon migrated up the Don, sturgeon were thick at its mouth and the Harbour itself was noted for its tremendous amount of herring and other fish[4].

The various stages and impacts of the settlement of the Toronto area and the development of Toronto Harbour are well documented elsewhere[2, 3, 5, 6, 7, 8, 9] and are visually depicted in Figures 3, 4 and 5. The Ashbridges Bay marsh area, though altered in various ways remained relatively intact until about 1912 (view 1, Figure 6) when it was filled in for industrial development by the Toronto Harbour Commissioners. By 1852 there were 37 mills (wood, food, clothing, etc.) dumping a variety of wastes into the Don River.



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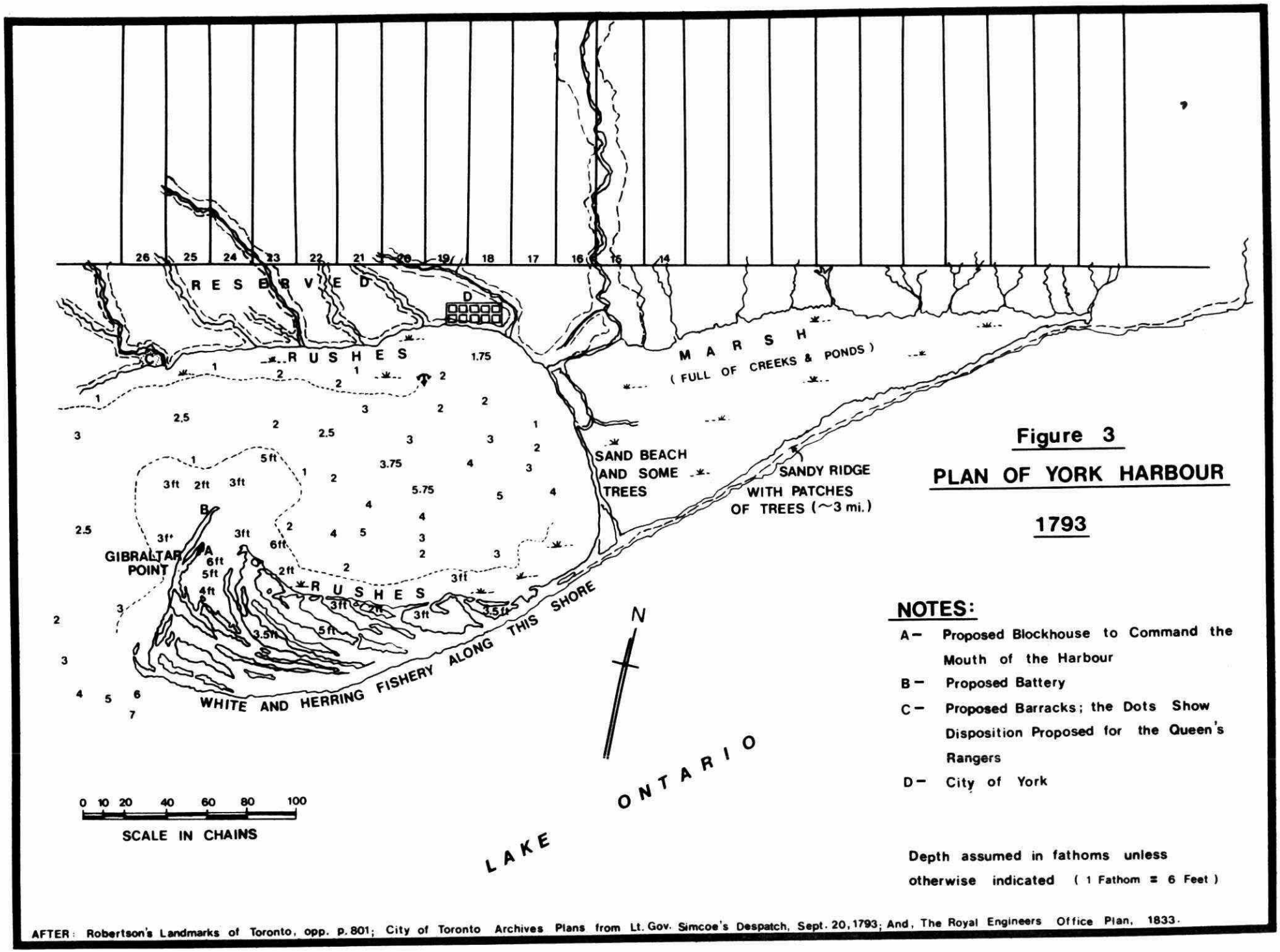


Figure 3

PLAN OF YORK HARBOUR

1793

NOTES:

- A – Proposed Blockhouse to Command the Mouth of the Harbour
- B – Proposed Battery
- C – Proposed Barracks; the Dots Show Disposition Proposed for the Queen's Rangers
- D – City of York

Depth assumed in fathoms unless otherwise indicated (1 Fathom = 6 Feet)

AFTER: Robertson's Landmarks of Toronto, opp. p. 801; City of Toronto Archives Plans from Lt. Gov. Simcoe's Despatch, Sept. 20, 1793; And, The Royal Engineers Office Plan, 1833.

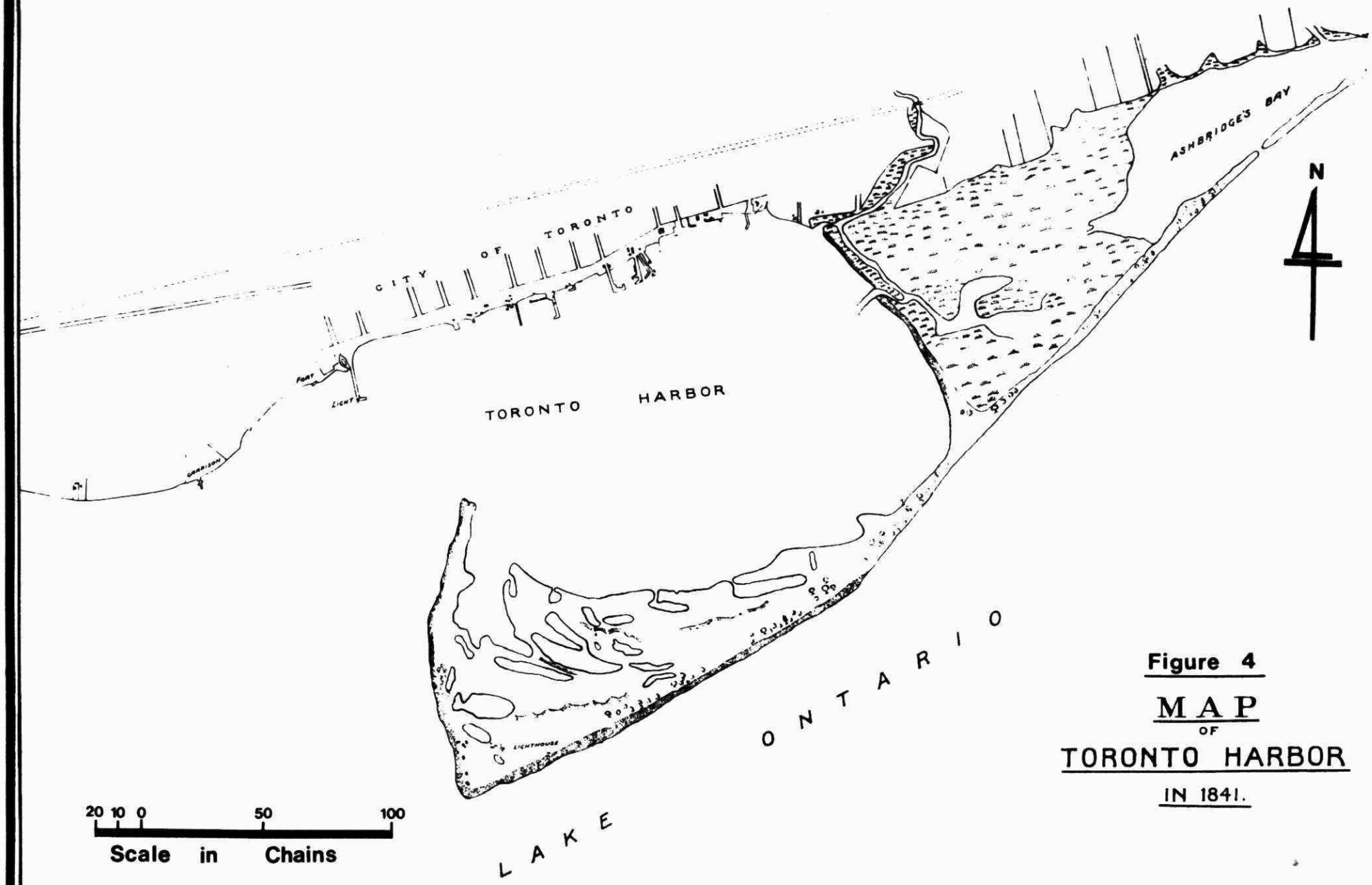


Figure 4

MAP OF TORONTO HARBOR IN 1841.

(Source : Toronto Harbour Commission DWG. No. 5983)

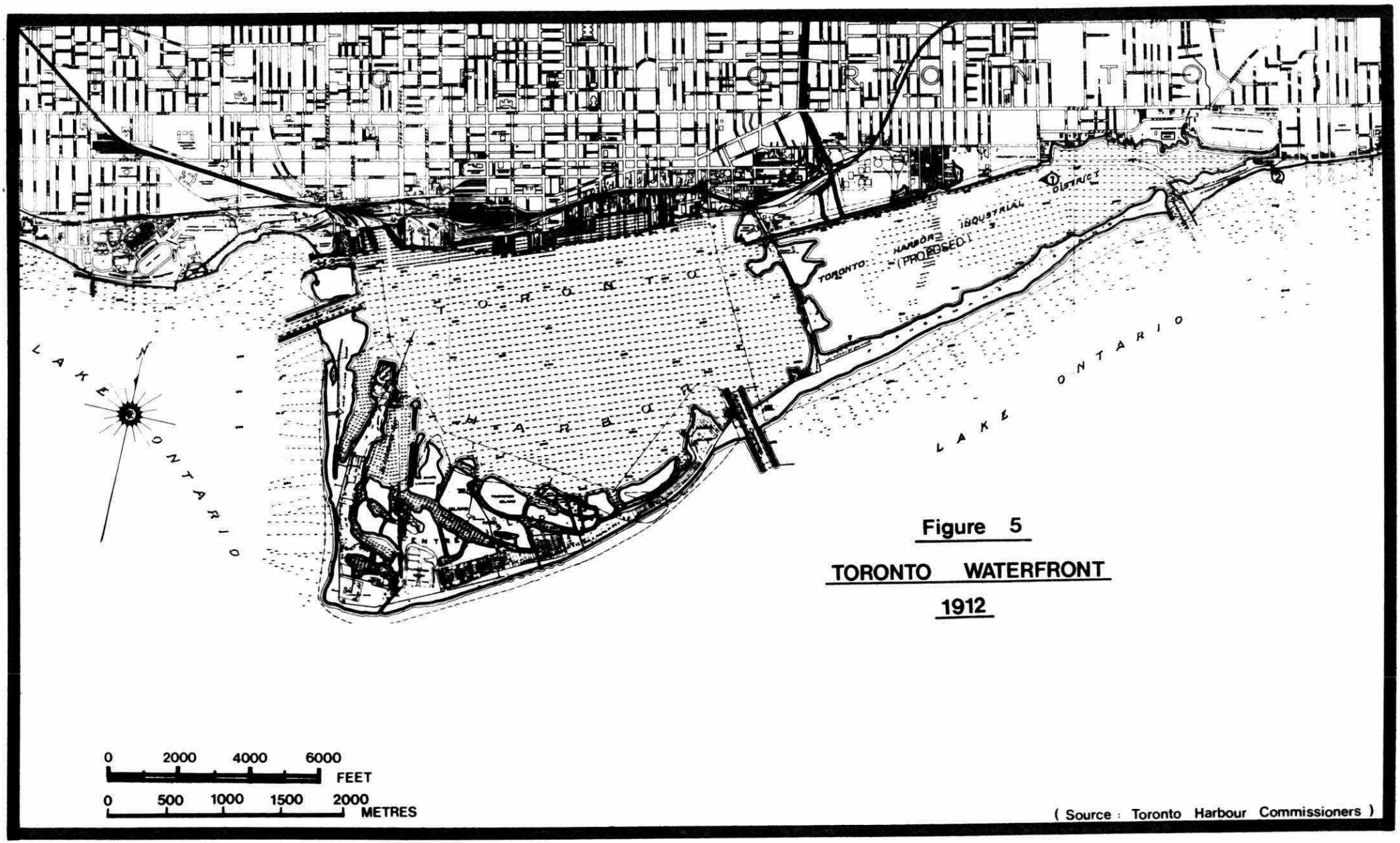


Figure 5

TORONTO WATERFRONT

1912

(Source : Toronto Harbour Commissioners)

These wastes combined with increasing agricultural runoff to produce a very polluted and silted river, emptying into and in turn silting the Harbour and Ashbridges Bay[9]. The Don River currently drains a large urbanized area (Figure 7) and is today a primary source of silt and many chemical and bacteriological contaminants in the Harbour.

Through the 1800's, the waters of Toronto Harbour became more and more polluted with a wide variety of industrial and domestic wastes[9, 10, 11, 12]. An interesting qualitative indication of the historical degradation of Toronto Harbour water quality is shown in the potable public water source summary provided in Table 1.

Table 1

POTABLE PUBLIC WATER SUPPLY
AND POPULATION SUMMARY - CITY OF TORONTO

YEAR	POTABLE PUBLIC WATER SOURCE	POPULATION
1803	Wells, springs, carried from Harbour	456
1823	Public pump in Market Square	9,254 (1834*)
1841	Water system constructed by "Toronto Gaslight and Water Company" taking water from Harbour.	14,249
1858-60	Pipe for Water Company extended further into Harbour due to increasing sewage problems.	45,288 (1861*)
1877	Sewage problem serious in Harbour. Wooden pipe built through Island after attempts at using sand for filter basins on the Islands failed. Water works now under municipal control.	70,867
1877 to present	All public water taken from "open lake".	

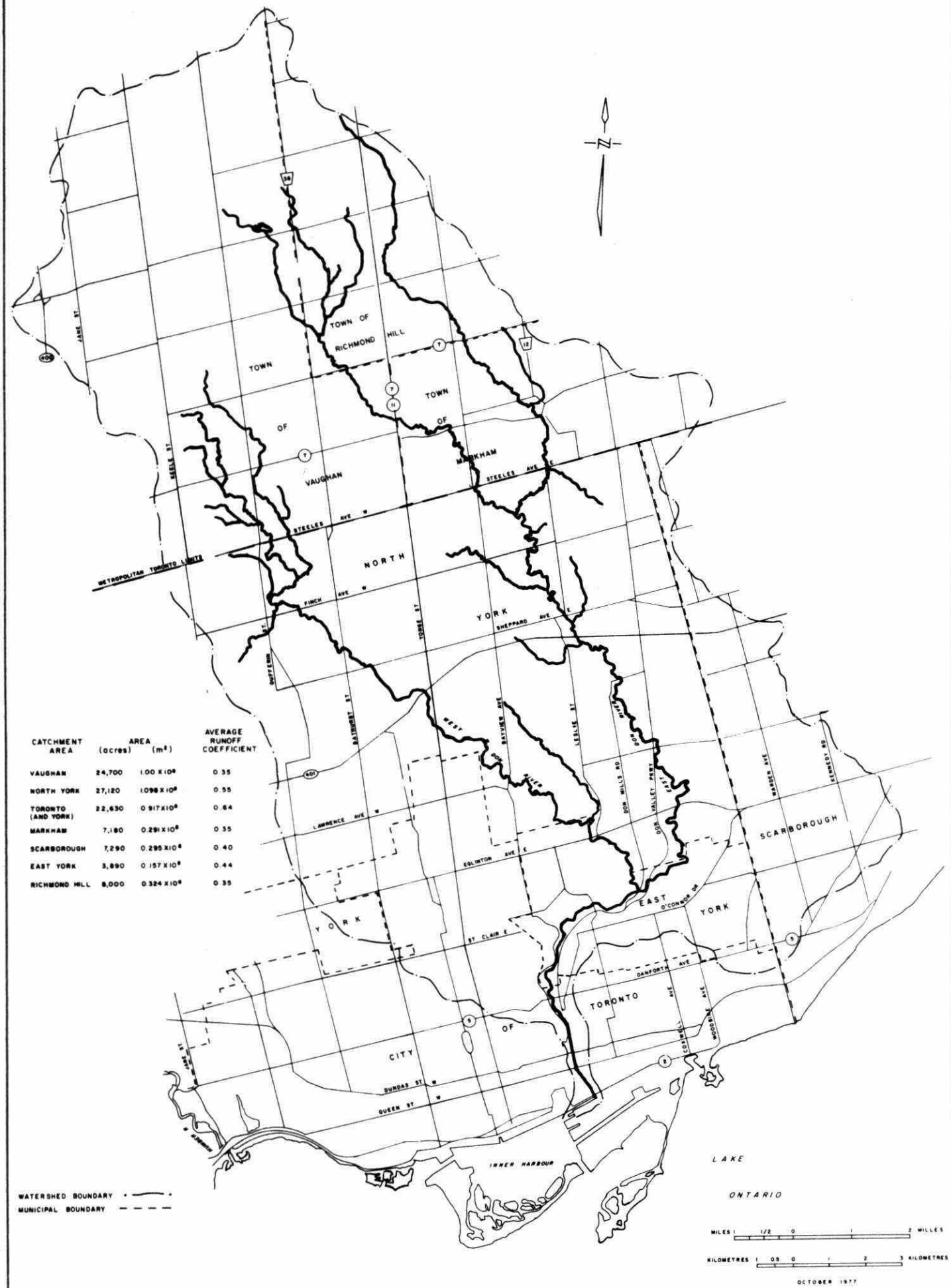
* Closest year for which data was available.

VIEW ◀①, Figure 5 – Looking west from the foot of Leslie Street, December 20, 1895.

VIEW ◀②, Figure 5 – Imhoff Tanks (Primary Treatment Facility), Kew Beach, c. 1900.

Figure 6 – PHOTOGRAPHS OF VIEWS INDICATED IN FIGURE 5.

(Source: City of Toronto Archives)



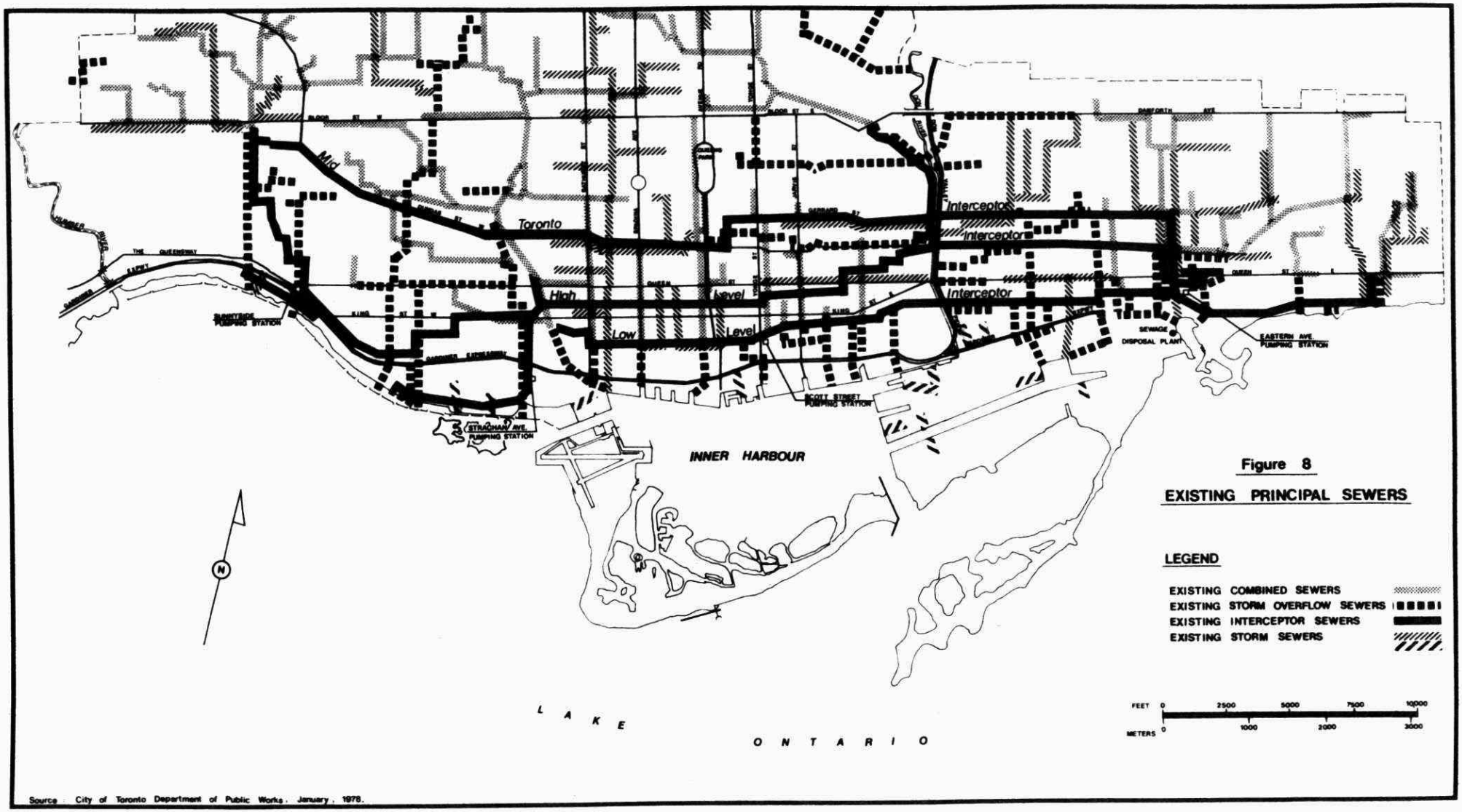
CATCHMENT AREA	AREA (acres)	AREA (m^2)	AVERAGE RUNOFF COEFFICIENT
VAUGHAN	24,700	1.00×10^8	0.35
NORTH YORK	27,120	1.098×10^8	0.55
TORONTO (AND YORK)	22,630	0.917×10^8	0.64
MARKHAM	7,180	0.291×10^8	0.35
SCARBOROUGH	7,290	0.295×10^8	0.40
EAST YORK	3,890	0.157×10^8	0.44
RICHMOND HILL	8,000	0.324×10^8	0.35

FIGURE 7 : DON RIVER WATERSHED AND CITY OF TORONTO.

By 1900 Toronto's population was some 181,000 people and almost 21 million gallons of sewage was being produced by the City per day. About 6,500 cu.yd. of "solid matter" (probably what is now called suspended solids) was discharged into the Harbour per annum, plus 12,000 cu.yds. from the Don River[11]. This gross pollution was largely relieved from 1909 to 1913 by construction of interceptor sewers, which dumped the bulk of the waste into Ashbridges Bay after primary (sedimentation) treatment, to remove heavier solids. This treatment facility (filter beds shown to west and south of Woodbine Race Course - Figure 5) was essentially two large Imhoff tank systems serving the areas to the west and to the east (view 2, Figure 6). During the period 1933-1940 a large sewage treatment facility at Ashbridges Bay was debated at Toronto City Hall culminating in the completion in 1951 of a primary treatment (i.e. removal of 30-35% organics, up to 50% suspended solids) plant at the present location (Figure 2). The Metropolitan Toronto government was formed in 1954 and was given responsibility for the trunk sewer system including the High and Low level Interceptors (Figure 8) and the sewage treatment facilities. By 1961 secondary treatment was in operation (i.e. removal of 90-95% of both BOD and suspended solids, using a multi-step biological process). Since 1974 the plant has also provided treatment for phosphorus removal.

(b) Recent Development of the Sewer System:

The existing sewer system for Toronto is shown in Figure 8. From the historical/geographical perspective, it is interesting to note how the sewer system above the Low Level Interceptor reflects the former location of small rivers and streams to the Harbour before major settlement (Figure 3). These streams were generally flowing year round and there were bridges over them on King and Queen Streets[9]. In 1965 the City of Toronto began a multi-million dollar sewer rehabilitation and separation programme. About 70% of the 780 miles of City sewers had become inadequate for then existing (1965) land use and proposed downtown development. Under storm conditions, storm flows mixed with sanitary overflow in combined sewers and emptied untreated into the harbour and lakeshore. The operation of the High and Low


Mid
Level
Toronto
High
Level
Low
Level
Interceptor
Interceptor
Interceptor
INNER HARBOUR
L A K E
O N T A R I O
N
Figure 8
EXISTING PRINCIPAL SEWERS
LEGEND
EXISTING COMBINED SEWERS
EXISTING STORM OVERFLOW SEWERS
EXISTING INTERCEPTOR SEWERS
EXISTING STORM SEWERS
FEET 0 2500 5000 7500 10000
METERS 0 1000 2000 3000
Source : City of Toronto Department of Public Works, January, 1978.

Level Interceptors did not allow sufficient capacity for dry weather flows[13] and thus there was always some overflow through diversion structures to the lake and harbour. There were 18 major City overflow outlets along the lake-shore and harbour, 9 on the Don River and 1 on the Humber River in 1965.

From 1966 to 1978 the operation of the City sewer system was reorganized and about 224 miles of new and rehabilitated sewers had been constructed at a total cost of about $87 million. Provincial subsidies for new construction and maintenance amounted to about $25 million and $4 million respectively[14]. Present City of Toronto plans now call for completion of the City Works programme* in 1985 with an additional net cost of $45 million, plus Provincial and other subsidies.

In 1969 Metro Toronto began construction of the Mid-Toronto Interceptor Sewer (Figure 8). This sewer was designed to relieve the overtaxed High and Low Level Interceptors and to accomodate increasing population and development. Construction was completed in 1978 at a total cost of about $32 million (about 17% paid by the Federal Government through CMHC, 15% financed by the Province and the balance funded by the municipality). It is anticipated that this interceptor will eventually permit elimination of all dry weather and some storm flows to the Harbour and lakefront of the City of Toronto.

Several storm overflow sewers from the local combined sewer system still empty into the Harbour (Figure 8). These provide a major source of both chemical and bacteriological contaminants, occurring primarily during and after rainfall events, due to effluent consisting of untreated stormwater (from roof drains and streets) and untreated sanitary flow from combined sewers.

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* Note: Under the Metropolitan Toronto government, the local municipality (i.e. City of Toronto) is responsible for all local collector sewers, whereas Metro is responsible for all trunk interceptor sewers and sewage treatment facilities.

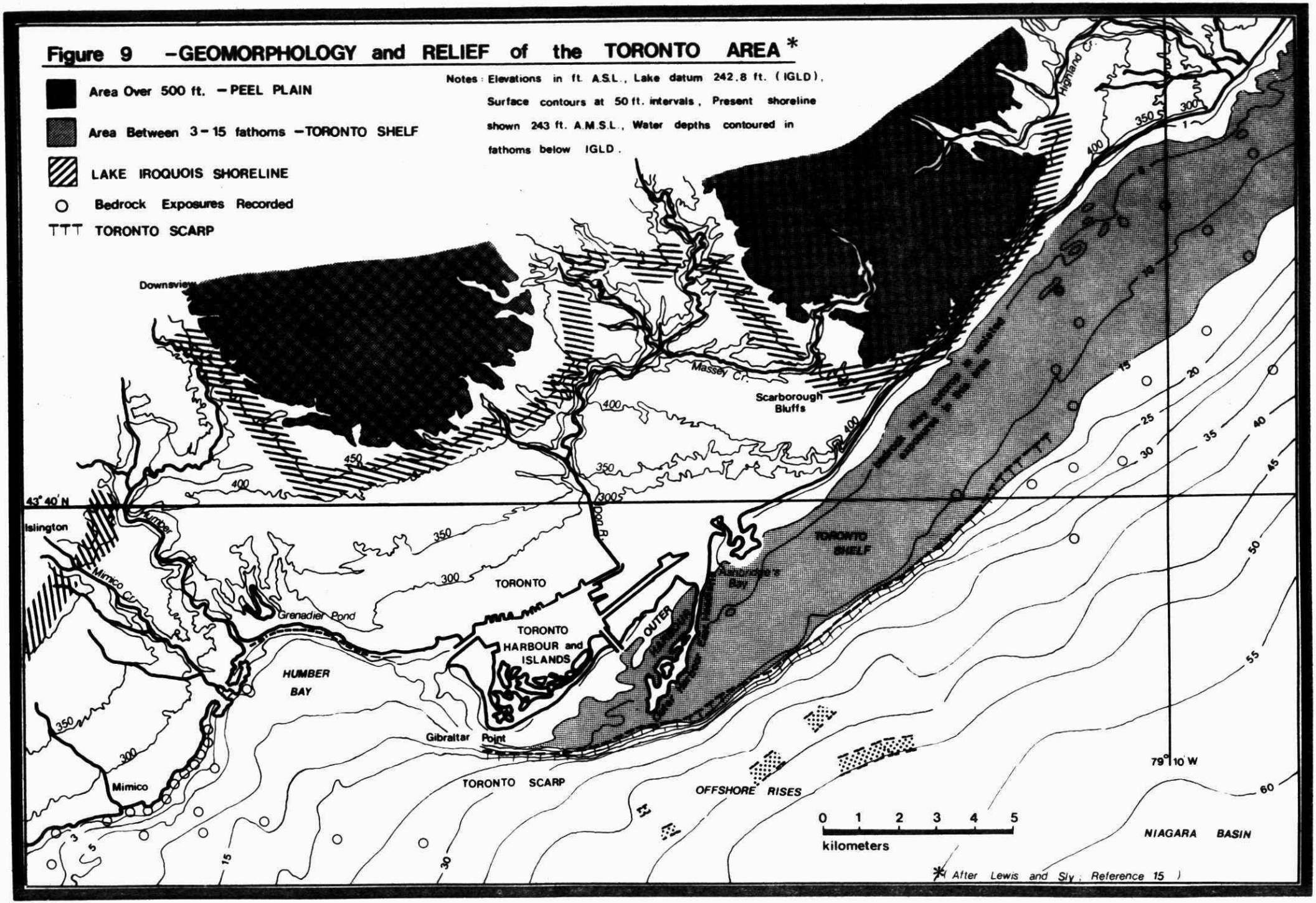


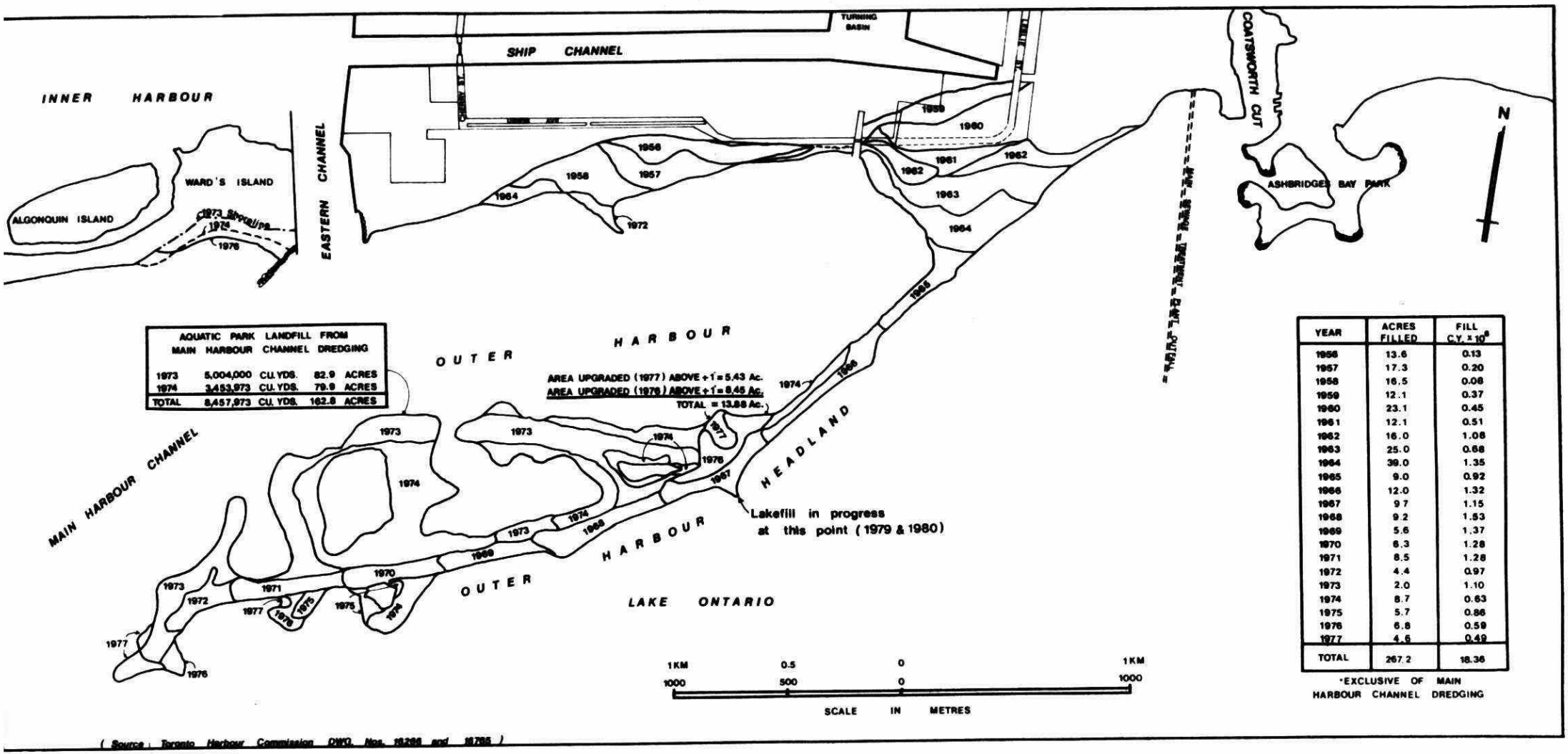
Figure 9 -GEOMORPHOLOGY and RELIEF of the TORONTO AREA *
Area Over 500 ft. - PEEL PLAIN
Area Between 3 - 15 fathoms - TORONTO SHELF
LAKE IROQUOIS SHORELINE
Bedrock Exposures Recorded
TTT TORONTO SCARP
Notes: Elevations in ft. A.S.L., Lake datum 242.8 ft. (IGLD), Surface contours at 50 ft. intervals, Present shoreline shown 243 ft. A.M.S.L., Water depths contoured in fathoms below IGLD.
Downsview
Highland Cr.
Massey Cr.
Scarborough Bluffs
43° 40' N
Islington
Humber R.
Mimico Cr.
Grenadier Pond
TORONTO
TORONTO HARBOUR and ISLANDS
OUTER
HUMBER BAY
TORONTO SHELF
Gibraltar Point
Mimico
TORONTO SCARP
OFFSHORE RISES
79° 10' W
0 1 2 3 4 5
kilometers
NIAGARA BASIN
* After Lewis and Sly; Reference 15)

(c) Geomorphology and Lakefills:

The natural and human forces at work on the evolution of geomorphological features in the Toronto area are described in detail elsewhere[9, 11, 16-22]. An understanding of the dynamics of currents and lake-harbour interactions can be grasped to some extent by briefly reviewing the factors governing the formation of lake features in the Toronto Harbour area.

The Scarborough Bluffs comprise the only place on Lake Ontario where the old Lake Iroquois shoreline intersects the existing shoreline of Lake Ontario (Figure 9). These Bluffs were the major source of the littoral materials which gradually formed the long sand peninsula and bay of Toronto Harbour as found by the original European colonists (Figure 3)[9]. The combination of wind energy and direction, wave energy, littoral transport, lake levels, silt from the Humber and Don Rivers, and current effects of the Don and Humber Rivers all interacting with each other, served to develop the Toronto Peninsula with its very steep offshore scarp (Figure 9).

The intensive farmland and settlement development which began in the early 1800's greatly increased both siltation of local rivers and erosion of the Scarborough Bluffs[9]. These accelerated erosion rates produced a significant increase in littoral deposits such that the west entrance to the Harbour decreased from a width of about 1,455 feet in 1800 to 200 feet by 1854[9], at which time a dredge was purchased by the Toronto Harbour Commissioners to keep the gap open. However, this relative abundance of littoral material was depleted by the end of the 1850's, as evidenced by the following natural events. A storm in 1858 broke a shallow channel 500 feet wide through the peninsula approximately where the East Gap is now located. Instead of gradually silting in with littoral deposits, the Gap continued to grow to about a mile across by 1882 and the very existence of the natural harbour was threatened[9, 22]. Since that time human effort, through the construction of dykes, breakwaters, lakefill and seawalls, has been the major factor in developing the Islands and Harbour and in maintaining them in their present configuration[9, 21].



AQUATIC PARK LANDFILL FROM MAIN HARBOUR CHANNEL DREDGING			
1973	5,004,000	CU. YDS.	82.9 ACRES
1974	3,453,973	CU. YDS.	79.9 ACRES
TOTAL	8,457,973	CU. YDS.	162.8 ACRES

YEAR	ACRES FILLED	FILL C.Y. x 10^6
1956	13.6	0.13
1957	17.3	0.20
1958	16.5	0.06
1959	12.1	0.37
1960	23.1	0.45
1961	12.1	0.51
1962	16.0	1.08
1963	25.0	0.68
1964	39.0	1.35
1965	9.0	0.92
1966	12.0	1.32
1967	9.7	1.15
1968	9.2	1.53
1969	5.6	1.37
1970	6.3	1.28
1971	8.5	1.28
1972	4.4	0.97
1973	2.0	1.10
1974	8.7	0.63
1975	5.7	0.86
1976	6.8	0.59
1977	4.6	0.49
TOTAL	267.2	18.36

*EXCLUSIVE OF MAIN HARBOUR CHANNEL DREDGING

(Source : Toronto Harbour Commission O.W.O. Nos. 18296 and 18795)

Figure 10 OUTER HARBOUR LANDFILL 1956 – 1977

By far the most significant geomorphological change in the study area in recent times is the construction of the Outer Harbour East Headland/Aquatic Park and Ashbridges Bay Park Lakefills (Figure 10). The Ashbridges Bay Park landfill area was completed by the Metro Toronto and Region Conservation Authority in 1977 and serves as a Metro Toronto public park and as a base for the Ashbridges Bay Yacht Club. This lakefill comprises excavated earth and construction rubble and quarried armourstone. The East Headland/ Aquatic Park lakefill was begun in 1959 and is still continuing. This lakefill comprises trucked earth and rubble, as well as sandy dredge spoil from the Outer Harbour-East Gap dredging operation during 1973 and 1974 (see Figure 10 for a summary of fill and dredge spoil quantities and sequencing of deposition). During 1979, the Harbour Commission began creation of a disposal area for Keating Channel dredge spoil on the lake side of the East Headland (Figure 10).

These two lakefills have provided increased park and boating facilities and significant new wildlife habitat[23,24]. However, they do have certain detrimental effects, including disruption of the current regime in this area of the waterfront[17]. Ministry of the Environment effluent dispersion studies at the Main S.T.P. outfall during 1978 and 1979 revealed low dilutions and silting problems which can be primarily attributed to the influence of the lakefills[25,26].

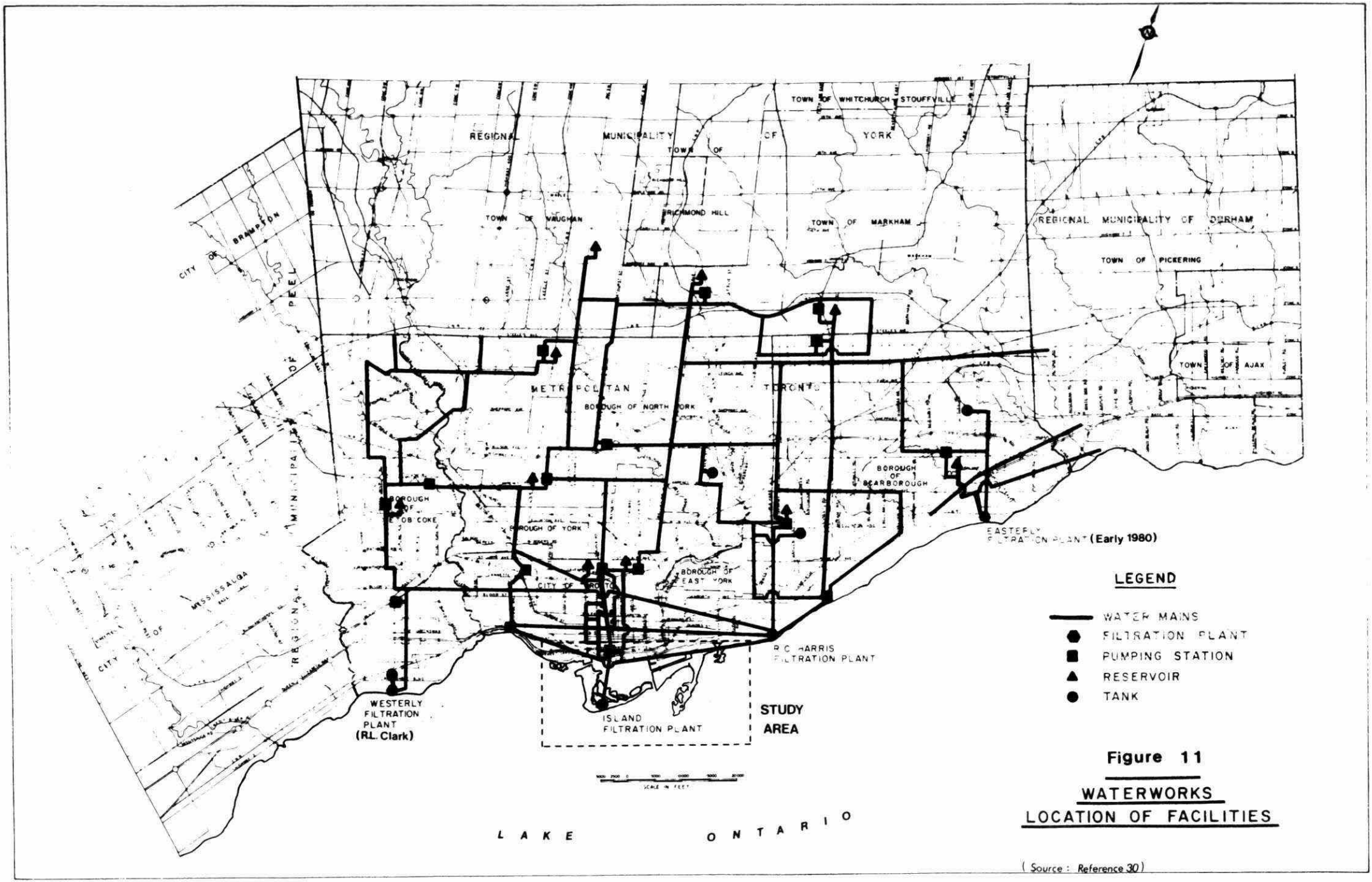


Figure 11

WATERWORKS
LOCATION OF FACILITIES

(Source : Reference 30)

III EXISTING WATER/LAND USES

(a) Water Supply:

The large population of Metropolitan Toronto requires a tremendous amount of raw fresh water for domestic and industrial use. The total average daily flow of the three Metro Toronto filtration plants (Figure 11) was 40.7% of the average daily water production of the filtration plants* throughout the Province of Ontario[27]. The three Metro plants (Figure 11) currently process about 4.45 x $10^8 m^3$ (or 98 billion gallons**) of raw lake water in a year[29]. The individual filtration plant capacities are as follows:

TABLE 2

METRO TORONTO WATER FILTRATION PLANT CAPACITIES

FILTRATION PLANT	CAPACITY	
	x $10^3 m^3$/day	MGD
R.L. Clark (formerly Westerly)	455	100
Island	475	104
R.C. Harris	1,000	220
Easterly (opening early 1980)	455	100

* All filtration plants which produce filter backwash and other process wastes as noted in References 27 and 28.

** All gallons in this report are imperial gallons unless otherwise indicated.

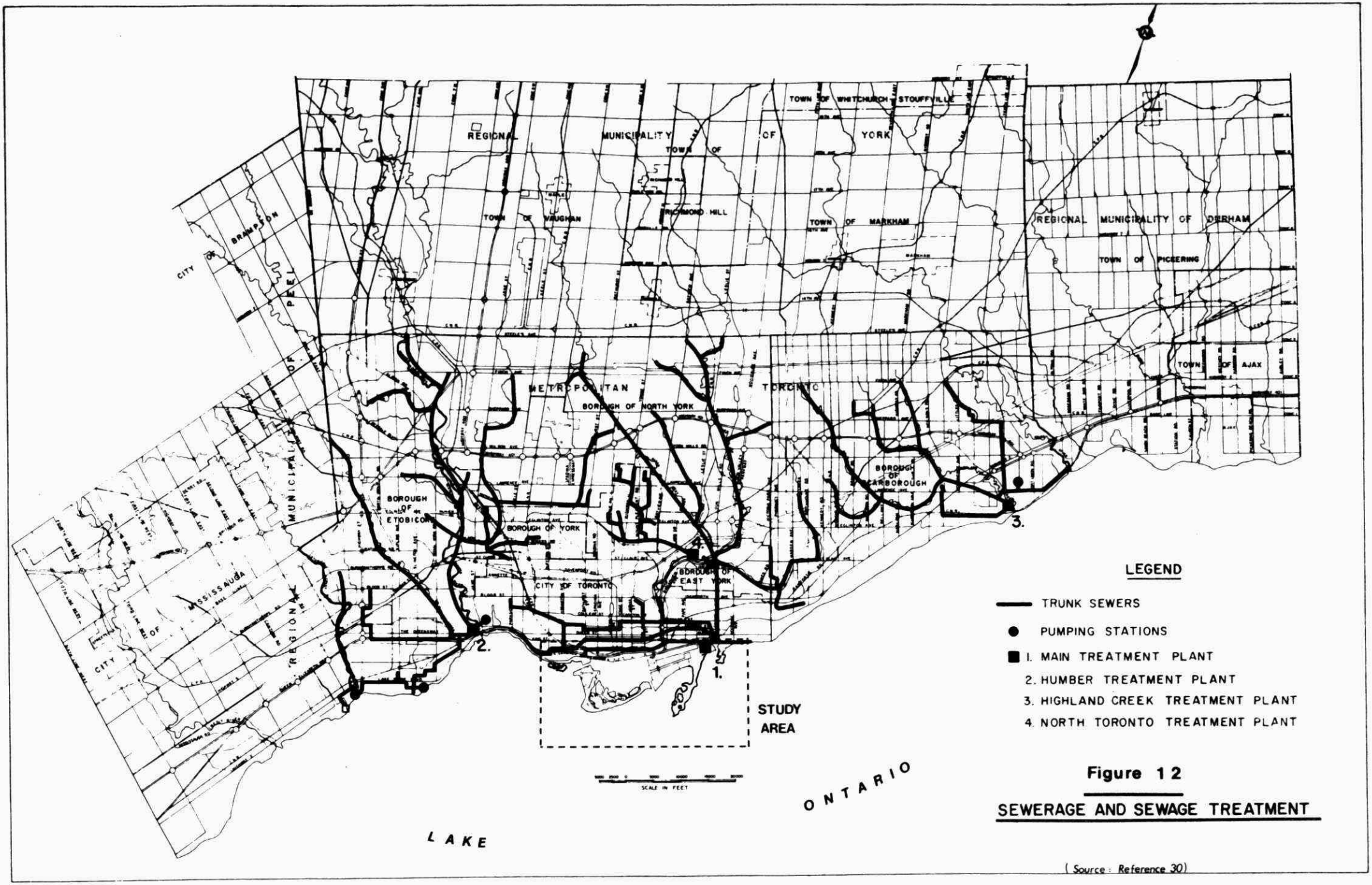


Figure 12

SEWERAGE AND SEWAGE TREATMENT

(Source: Reference 30)

The Easterly filtration plant shown in Figure 11 is presently under construction and is scheduled to start operation in early 1980[31]. The Island filtration plant located within the study area operates only during the summer months (the peak load period for water supply in Toronto).

(b) Sewage Treatment

There are four sewage treatment plants serving Metro Toronto (Figure 12) which had a total flow to the lake of approximately 4.4 x $10^8 m^3$ in 1977 (97 billion gallons)[32,33]. Individual plant capacities are as follows:

TABLE 3

METRO TORONTO SEWAGE TREATMENT PLANT CAPACITIES

SEWAGE TREATMENT PLANT	CAPACITY			
	EXISTING		PROPOSED	
	x $10^3 m^3$/day	MGD	x $10^3 m^3$/day	MGD
Main STP	818	180	910 (by 1982)	200
Humber STP	284	62.5	409 (by 1982)	90
Highland Creek STP	145	32	291 (after 1982)	64
North Toronto STP	45	10	no expansion	

RANGE OF CONCENTRATIONS IN OBSERVED COMPOSITION OF COMBINED SEWAGE AND STORMWATER

CONSTITUENT	URBAN TEST CATCHMENTS						
	COMBINED SEWAGE		STORMWATER				
	BANNATYNE	FAIRFIELD	BARRINGTON	BRUCEWOOD	FAIRFIELD	MALVERN	WINDSOR
(mg/litre) BOD	32-1730	90*	11-320**	0.6-110	45*	1-131	0-78
COD			40-880**	20-920		7-840	
Chloride			5-255**	2-3240			4-1585
Lead			0.5-1.8**	0.2-1.8		0.5-0.9	
Nitrates			0.2-1.9**	0.2-4.0		0.01-11.0[A]	0-4.7
Nitrites			0.02-0.9**	0.02-0.26			0.001-0.57
Ammonia			0.1-5.2**	0.1-3.3		0.005-2.3	0-0.71
Total phosphorus			0.32-11.0**	0.1-1.6		0.01-5.4	
Suspended solids	430-7700	90-1885**	60-630**	15-770	36-680**	1-1080	23-1230
(MPN/100 ml) Total coliform		5.5×10^{7}*	1.0×10^{4} to 2.0×10^{8}**	1.0×10^{2} to 8.2×10^{4}	4.9×10^{6}*	1.4×10^{3} to 5.6×10^{6}	2.0×10^{2} to 1.2×10^{6}
(MPN/100 ml) Fecal coliform		1.7×10^{6}*	1.0×10^{3} to 2.4×10^{6}**	1.0×10^{1} to 7.3×10^{3}	1.0×10^{4}*	1.0×10^{2} to 3.3×10^{5}	1.0×10^{1} to 2.0×10^{5}
Reference source	39 42	49	39	28	49	36	10

*Arithmetic mean value

**Range of event maximum values

[A]Nitrates plus Nitrites

FIGURE 13 - SELECTED CANADIAN URBAN TEST CATCHMENTS

(AFTER J. MARSALEK, REFERENCE 34)

The North Toronto plant has both a direct discharge by trunk sewer to the Main STP at Ashbridges Bay and a direct discharge into the Don River which then enters into Toronto Harbour and then into the lake. Examination of municipal discharge statistics for Lake Ontario and tributaries[33] illustrates the degree of potential impact of the Metro Toronto discharge on the study area and on the region. Metro Toronto contributed 50% of Canadian municipal discharge to the lake and 27% of all U.S. and Canadian municipal discharge to the lake in 1977. Table 4 below is a summary of data[33] which illustrates that Metro Toronto's four sewage treatment plants account for 35% of all Canadian municipal discharge to all of the Great Lakes.

TABLE 4

CANADIAN MUNICIPAL DISCHARGE TO THE GREAT LAKES 1977

LOCATION	TOTAL DISCHARGE ($x10^8 m^3$)
Lake Superior	.24
Lake Huron	.92
Lake Erie	2.49
Lake Ontario	8.80
TOTAL	12.45

It is interesting to note that the total water filtration plant processing is almost equal to the total sewage treatment plant flow in Metro Toronto and that, on a per capita basis, treated water used in Metro Toronto is .58 m^3/person/day (126 gallons/person/day) and sewage produced is .57 m^3/person/day (125 gallons/person/day).

The sewage figures discussed above do not include unmeasured system overflows or flows from storm sewers which discharge directly into Lake Ontario or its tributaries. As can be seen from Figure 13, stormwater is of highly variable quality with significant levels of chemical and bacteriological contaminants.

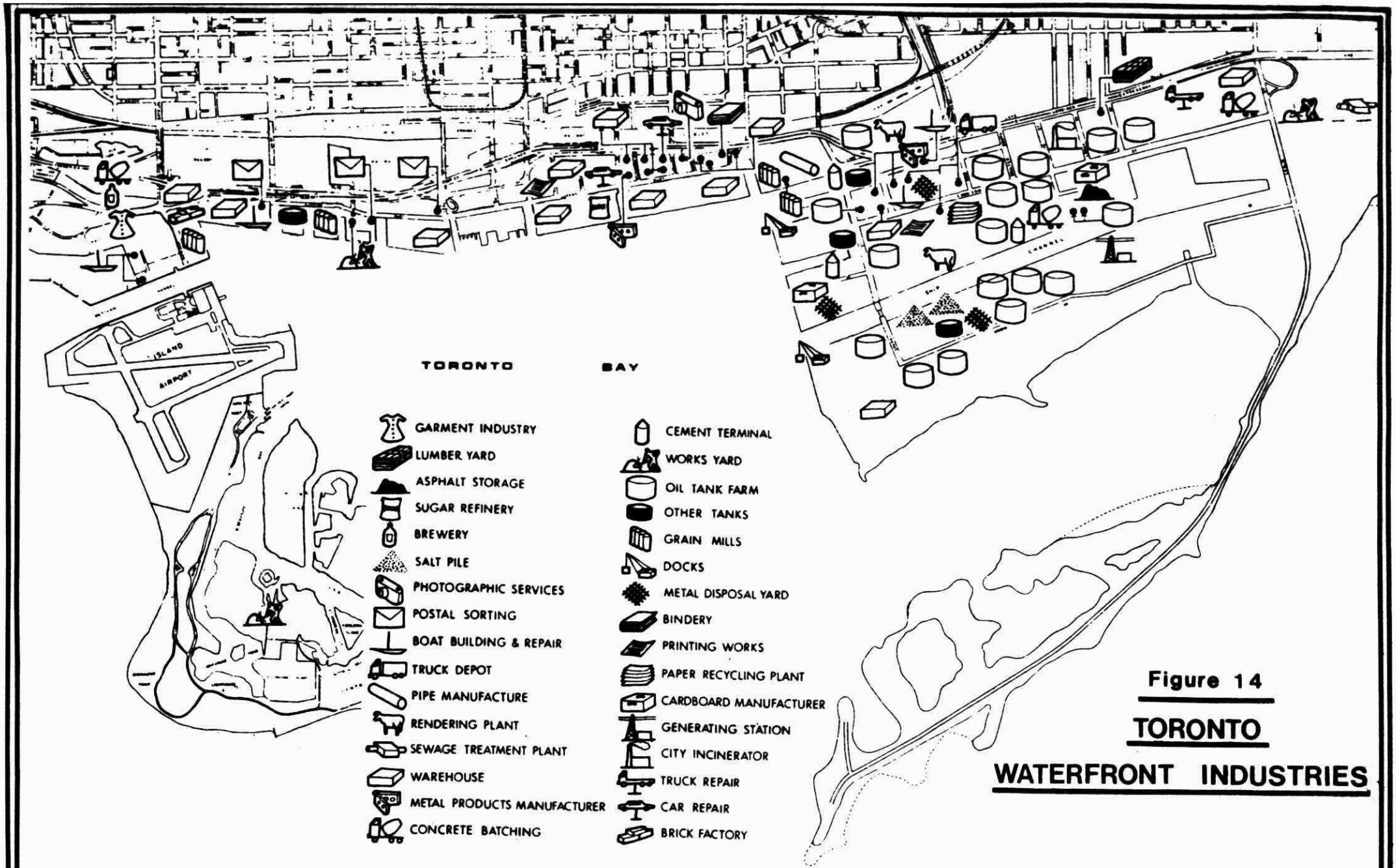


Figure 14

TORONTO

WATERFRONT INDUSTRIES

(Source : Reference 5)

(c) Industry:

Industrial uses have been well described in other studies[5, 35] and are summarized in Figure 14. All industries within the area discharge their process effluent to the municipal sanitary collection system. Only cooling water is discharged into the harbour; thus, for the most part, direct industrial effluent is not an apparent problem. All visible cooling water discharges on the north shore of the Inner Harbour were analyzed in 1975 and none was found to be significant[6]. There are, however, periodic oil discharges into the Spadina and Simcoe Street Slips "which have necessitated the installation of oil booms" in the slips[6]. These booms are not found to be particularly effective during periods of storm[6]. The source of this oil appears to be the railway yards and the urban runoff from industrial, commercial and residential areas just north of this section of the waterfront.

(d) R. L. Hearn Thermal Generating Station:

The R. L. Hearn Thermal Generating Station was opened in 1953 and is located at the east end of the Ship Channel of Toronto Harbour (Figure 2). Its 8 units have provided peak load electric power into the main Ontario Hydro bulk power system. For condenser cooling water, the plant construction replaced a former open channel between the Ship Channel and Lake Ontario with a large pumping facility which takes water from the Ship Channel, through the condensers and discharges it through the outfall channel (at higher temperature) to the Outer Harbour (Figure 2).

During the periods of intensive surveys in 1976, 1977 and 1978 the Hearn G.S. provided a significant beneficial function for water circulation in the Inner Harbour by pumping from 1.3 to 6.7 % of the total Inner Harbour volume per day into the Outer Harbour*. This in turn consisted of from 2.5 to 12.3% of the Outer Harbour water volume per day[36]. Although the circulation aspect provides open lake

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* The author has estimated Inner and Outer Harbour volumes to be approximately $35.96 \times 10^6 m^3$ and $3.275 \times 10^6 m^3$ respectively (chart datum 74.0 m).

water exchange benefits to the Outer Harbour, the increased temperature and Inner Harbour contaminants tend to be detrimental to water and sediment quality in the Outer Harbour. The increased temperature and water flow has however served as a major attraction for fish, and thus for fishermen, in this area (Figure 19).

Because of Ontario Hydro's excess power capacity, 4 of the 8 generating units at the Hearn G.S. were recently (summer 1979) taken out of service by Ontario Hydro. (A fifth unit may also be shut down)[36]. If this halves the former water exchange between the Inner harbour and the Outer Harbour and Lake Ontario, a degradation of water quality in the Inner Harbour (particularly in the Ship Channel) may become apparent in the future.

(e) Port Uses:

The Port of Toronto has a variety of cargo storage and handling facilities, most of which are located at the eastern end of the harbour. There are extensive outside storage and warehouse storage areas, grain elevators, coal docks, dry bulk cargo docks (cement, salt, sugar) and liquid cargo docks (chemicals, oil, molasses, alcohol, tallow). Potential influences on water quality could arise from ship oil spills, pipeline failures and the salt and coal storage areas. Surveillance for oil spills is the responsibility of Transport Canada who conduct five-day-a-week surveillance patrols utilizing a Toronto Harbour Police boat.

(f) Fish and Wildlife:

Recreational sport fish found in the Metro Toronto area include: bowfin; coho and chinook salmon; rainbow, brook and brown trout; splake; round whitefish; rainbow smelt; northern pike; carp; creek chub; whitesucker; brown bullhead; channel catfish; american eel; white perch; white, rock, smallmouth and largemouth bass; pumpkinseed; bluegill; black crappie; yellow perch; yellow pickerel; and freshwater drum[37]. Popular fishing locations in the study area are shown in Figure 19 and complete details on all fish varieties in the Toronto area, with habitat, size, angling methods and cooking details are provided in reference 37.

Sport fish samples dating from 1975 to 1978 from Toronto Harbour and area exhibited elevated levels of PCB and mirex[38,39]. All species of fish tested had PCB concentrations greater than 0.1 ppm (i.e. above 1978 Agreement objectives for protection of wildlife). Larger sizes of bullhead, whitesucker, white bass, yellow perch, northern pike, and carp were above the 2 ppm Canadian federal guideline for PCBs in fish for human consumption. Sport fish collections have been planned for 1980 to update existing records and determine if there are any trends in contaminant levels. Levels of mercury in sport fish in the area were not indicative of any significant mercury sources. Lead levels in fish were generally low in the Toronto area. Details on edibility of various species and sizes of fish are found in the provincial "Guide to Eating Ontario Sport Fish" [39].

The study area supports a wide variety of wildlife and wildlife habitat which are described in detail elsewhere[7, 23, 24, 40]. Figure 15 shows the designated natural areas within the study area as well as areas which are undeveloped and provide natural wildlife habitat. The majority of the wildlife species (turtles, snakes, frogs, mallards, Canada geese, diving ducks such as Oldsquaw, Bufflehead and Greater Scaup and gulls and terns)[7, 23, 24] utilize the water environment directly, and therefore depend on good water quality to maintain viable food supplies and generally healthy populations. The Toronto Islands and East Headland also form a key part of the bird migratory stopover system along the north shores of Lakes Erie and Ontario[7].

(g) Housing:

Existing and proposed commercial and housing developments in the study area are described in detail elsewhere[5, 41]. Housing near water primarily requires a water quality of good aesthetic and olfactory quality. Impacts of existing housing on water quality in the study area are primarily restricted to potential contamination from poor septic tank operation on some of the island homes.

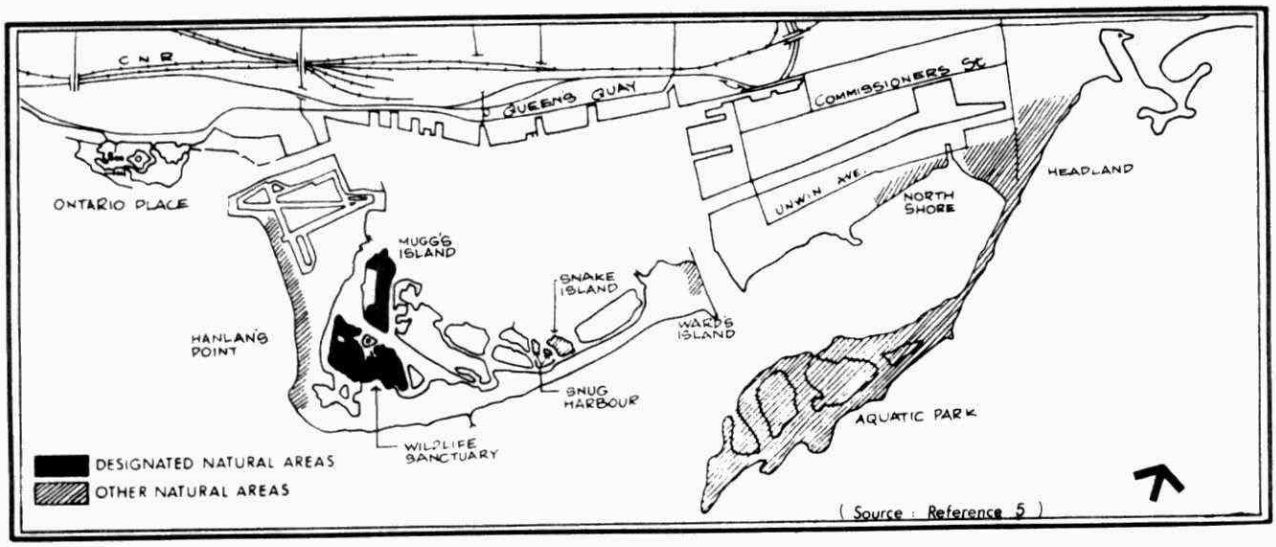

Figure 15

TORONTO WATERFRONT NATURAL AREAS

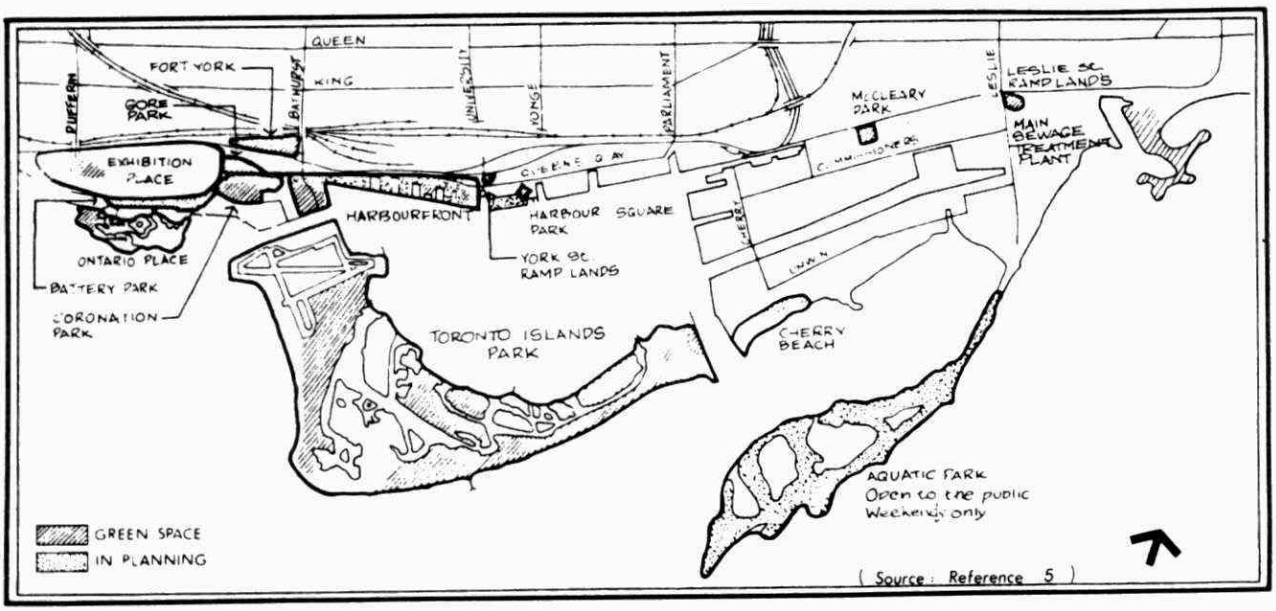

Figure 16

TORONTO WATERFRONT PARKS

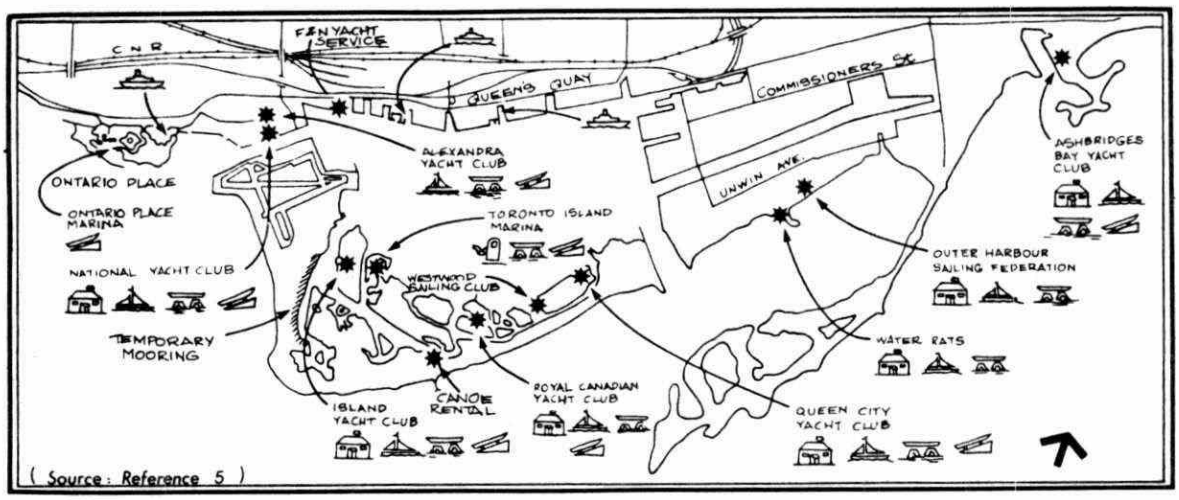

Figure 17

TORONTO WATERFRONT BOATING FACILITIES

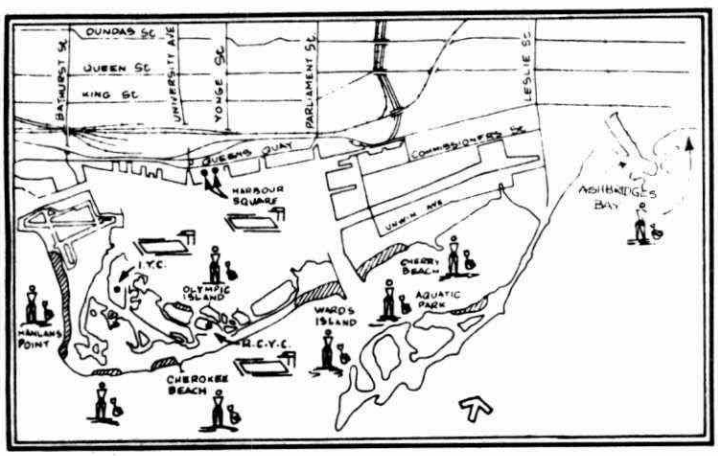

Figure 18

SWIMMING AREAS (Source : Reference 5)

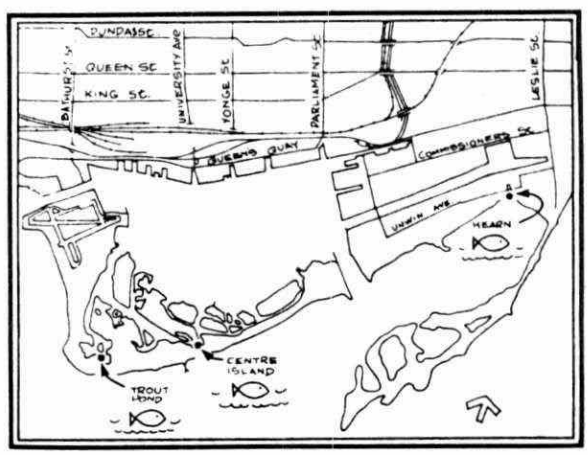

Figure 19

FISHING AREAS (Source : Reference 5)

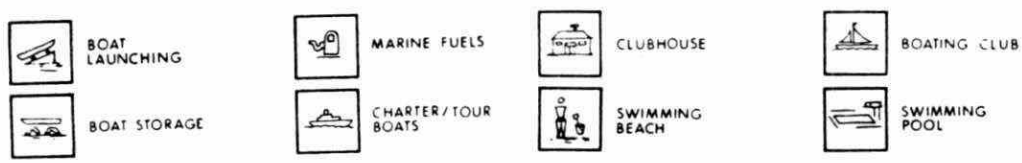

TABLE 5 EXISTING SMALL CRAFT FACILITIES CITY OF TORONTO WATERFRONT JULY 1977

NAME OF FACILITY	TYPE	WET BERTHS	DRY SAIL	TOTAL	WINTER STORAGE	LAUNCHING RAMPS	LIFT OUT	FUEL & OIL	PUMP OUT	REPAIRS	BOATING INSTRUCTION
CLUBS and MARINAS											
1) Alexandra Yacht Club	Conventional Club	59 (including 12 Visitor)		59	√				√		√
2) Ashbridges Bay Yacht Club	Conventional Club	117 (including 35 Visitor)	90	207	√	√(2)	√	√	√		√
3) Boulevard Club	Conventional Club	110 (including 1 Visitor)	62	172	√	√(2)	√				√
4) Island Yacht Club	Conventional Club	200 (including 2 Visitor)	50	250	√			√			√
5) National Yacht Club	Conventional Club	246	65	311	√			√	√		√
6) Outer Harbour Sailing Federation / Water Rats Sailing Club	Community & Conventional Club	12	403	415	√	√					√
7) Queen City Yacht Club	Conventional Club	117 (including 2 Visitor)	50	167	√	√(2)		√	√		√
8) Royal Canadian Yacht Club	Conventional Club	306	126	432	√	√(3)	√	√	√	√	√
9) Toronto Sailing & Canoe Club	Conventional Club	85 (including 15 Visitor)	183	248	√	√(2)			√		√
10) Ontario Place Marina	Marina	286 (including 12 Visitor)		286					√		
11) Toronto Island Marina	Marina	400	50	450	√		√	√	√	√	√

* Visitor Slip figures are approximate and are taken from Small Craft Harbours Study - Metropolitan Toronto & Region Waterfront, 1975 or by telephone.

OTHER FACILITIES

Slips (Wet Berths)	T.H.P. Basin	15
	Various Other Locations	20
Sailing Instruction	Harbour Front Sailing School	
	Harbourside Sailing School	
	Pier 4 Sailing School	
	Toronto Brigantine	
Public Launching Ramps	Sunnyside - 1	
	Spadina Street Slip - 1	
	Ashbridges Bay - 6	

Westwood Sailing Club** - 15 dry sail spaces (Agonquin Island)

North Toronto Sailing Club** - 12 dry sail spaces (Island Marina)

SUMMARY OF EXISTING FACILITIES

TOTAL WET BERTHS	1,941
TOTAL DRY SAIL	1,106
COMBINED TOTAL BOAT ACCOMMODATION	**3,047**
VISITOR SLIPS (approximate)	79
PUBLIC LAUNCHING RAMPS	8

** Small Community Club

(h) Recreation:

Recreation uses within the study area are intensive and varied. Recreation is probably the most sensitive of human water uses to changes in water quality. Detailed reviews of recreation in the study area are provided in many planning reports[5, 41, 42, 43]. A map of existing parks in the study area is found in Figure 16. Recreational water uses vary from aesthetic impacts on passive viewing, walking and field and court sports to water intensive activities, such as boating (ferries, tours, sailing, power boating, canoeing), swimming and fishing. Location maps of water related recreational uses are provided in Figures 17 (boating facilities), 18 (swimming areas) and 19 (fishing areas).

With regard to boating, a total of at least 1,743 wet berths and 834 dry sail spaces are found in the study area (Figure 17) in addition to 7 small boat launch ramps[43]. Table 5 provides a summary of small craft facilities within the City of Toronto waterfront, an area slightly larger than the detailed study area for the MOE environmental studies. During the summer season the Inner Harbour is very congested with recreational boating, and congestion and boating activities are increasing outside the West Gap and in the Outer Harbour [43]. Water quality is important to boating with respect to aesthetics, floating debris, oil slicks coating hulls, fouling of hulls and engines due to excessive Cladophora growth and bacteriology (when boaters fall overboard or overturn their small craft).

High intensity use of the Island Park sanitary facilities during the Mariposa Folk Festival, International picnic, rock concerts, etc. has in the past overtaxed the septic systems causing localized bacteriological contamination problems[8,44]. A new forcemain sewer system was completed in June 1978 and now serves most of the Island Park facilities. The existing homes on the Islands are not connected to this new system at the present time. The Island ferries (Figure 20) provide access to the Island Parks and homes and carry well over a million passengers per year. Peak day traffic can reach over 40,000 passengers and the months of June, July and August account for about 70% of the total annual passenger load[45].

FIGURE 20 – Toronto Island Ferries carry over 1 million passengers annually.

FIGURE 21 – Bathers at Cherokee Beach on Lake Ontario side of Toronto Islands.

– photos courtesy of Metro Parks Dept.

Bathing at local beaches is popular in the study area (Figures 18 and 21) in spite of chilly water caused by the periodic phenomena of cold bottom lake water upwelling during July and August. Potential conflicts can arise between bathing and bacteriological contamination from storm and sanitary sewer and sewage treatment plant outfalls. Of particular concern is the Olympic Island Beach which is located in the Inner Harbour and was not in compliance with MOE water quality objectives from 1974 to 1977. [38,46] Recent improvement in bacteriological quality may be due to the new sewer forcemain installed by Metro Parks Department on the Islands.

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